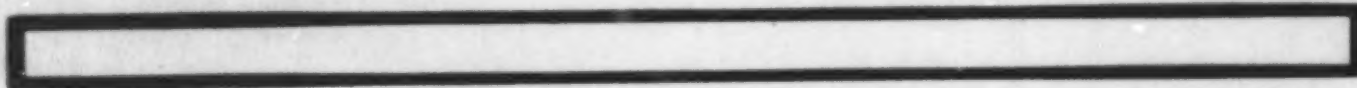


PB87-108965

Pesticide Fact Sheet Number 75: Captan,
N-trichloromethylthio-4-cyclohexene-1,2-
1,2-dicarboximide

(U.S.) Environmental Protection Agency
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Pesticide Fact Sheet

Name of Chemical: CAPTAN, N-trichloromethylthio-4-cyclohexene-1,2-dicarboximide
Reason for Issuance: Issuance of Registration Standard
Date Issued: March 6, 1986
Fact Sheet Number: 75

1. Description of Chemical

Generic Name: N-trichloromethylthio-4-cyclohexene-1,2-dicarboximide

Common Name: Captan

Trade Names: Merpan, Orthocide, SR-406, and Vancide 89

EPA Shaughnessy Code: 081301

Chemical Abstract Service (CAS) Number: 133-06-2

Year of Initial Registration: 1951

Pesticide Type: Fungicide

U.S. Producer: Chevron Chemical Company
Stauffer Chemical Company
Makteshim Beer Sheva Chemical Works, Ltd.
Calhio Chemicals, Inc.

2. Use Patterns and Formulations

Application Sites: Captan (N-trichloromethylthio-4-cyclohexene-1,2-dicarboximide) is a fungicide federally registered for use on almonds, apples, apricots, asparagus, avocados, beans, beets, blackberries, blueberries, broccoli, Brussels sprouts, cabbage, cantaloupes, carrots, cauliflower, celery, cherries, corn (sweet), cotton, cranberries, cucumbers, dewberries, eggplants, grapefruits, grapes, honeydew melons, kale, lemons, lettuce, limes, mangoes, mustard, nectarines, onions, oranges, peaches, pears, peas, peppers, pineapples, plums, potatoes, pumpkins, quinces, raspberries, rhubarb, rutabagas, soybeans, spinach, squash, strawberries, tangelos, tangerines, taro, tomatoes, turnips, and watermelons. The following crops may be seed-treated: Alfalfa, asparagus, barley, beans, beans (lima), beets (table), bluegrass, broccoli, Brussels sprouts, cabbage, cantaloupes, carrots, cauliflower, clover, collards, conifers (Douglas fir, Red pine, Scotch pine, Norway spruce), corn (field and sweet), cotton, cowpeas, crucifers, cucumbers, eggplants, flax, forage grasses, kale, lentils, lespedeza, millet, milo, muskmelons, mustard, oats, okra, onions, peanuts, peas, peppers, pineapples, pumpkins, radishes, rape, rice, rutabagas, rye, safflower, sesame, small-seeded legumes,

sorghum, soybeans, spinach, squash, sugar beets, sunflowers, Swiss chard, tomatoes, trefoil, turnips, watermelons, and wheat. Ornamental crop uses include: foliar applications to azaleas, begonias (tuberous), camellias, carnations, chrysanthemums, dichondra, grasses (ornamental in nonpastered areas only), grasses (lawn seedbeds), hollyhocks, lilacs, snapdragons, spireas, roses, and stocks; for soil in plant beds and on green house benches used for the culture of flowers, roses shrubs and trees; and as a dip application to gladiolus corms, to begonia tubers, and to azalea cuttings. Captan may be applied to packing boxes for use in storage and shipping of fruits and vegetables and to soil used in greenhouses for culture of ornamentals and vegetables.

Household Uses Include: application to fruit, vegetable and ornamental gardens, house plants and lawns, in paints (oil based), on surfaces (awnings, blankets, boats, closets, clothing, draperies, floors, leather goods, luggage, mattresses, rugs, shoes, storage rooms, upholstery, walls, workshops, and on other articles. Industrial uses include incorporation into lacquers, paints (oil based), paper, paste (wallpaper flour), plasticizers, polyethylene, rubber stabilizer, textiles, vinyl, and vinyl resins.

Types of Formulations: Dusts, wettable powders, aqueous suspensions, and granules.

Types and Methods of Application: Dusting, spraying, misting, dipping, mixing, and low pressure bomb aerosols.

Application Rates: See use patterns in USDA Compilations of Registered Uses of Fungicides and Nematicides, Part I, Pages C-10-00-01 to C-10-00.21.

Usual Carriers: Clay, talc, silica, and water.

3. Scientific Findings

Chemical Characteristics:

Physical State:	Pure is white crystals, technical is white to buff colored amorphous powder.
Color:	White to buff
Odor:	Pure is odorless, the technical is pungent.
Melting Point:	158-164 °C
Vapor Pressure:	Less than 10^{-6} mm Hg at 25 °C.
Solubility:	Practically insoluble in water, soluble in acetone, ethanol, kerosene, xylene, chloroform, and benzene.
Stability:	Regarded as stable. Decomposes slowly at the melting point. In solution captan decomposes rapidly depending on the pH and temperature, being slower at pH 4 and rapid at pH above 10.

Toxicity Characteristics:

Acute Oral LD₅₀ - Rat - 9 gm/kg, Category IV

Acute Inhalation LD₅₀ - Rat - males 5.8 mg/L, Category III
- females > 8.9 mg/L, Category III

Eye Irritation - Rabbit - corneal opacity, iris and conjunctive irritation present through day 21, Category I.

Dermal Sensitization - Moderate sensitizer.

Subchronic Rodent - Filled by the 2 year chronic feeding study in rats.

Teratogenicity - Rabbit - not teratogenic at 6, 12, 25, or 60 mg/kg/day. Maternal toxicity observed as weight loss at high dosage.

- Hamster - dosed at 50, 200, and 400 mg/kg/day. Severe maternal weight loss at 400 mg/kg/day. Incidence of skeletal abnormalities; i. e., fused ribs, was increased at high dosage. These lesions were considered to be within normal background incidence.

Reproduction and Fertility Effects (feeding)

- a. Three Generation Reproduction Study - Rats: Rats were fed 25, 100, 250, and 500 mg/kg/day for three generations. Body weight reductions occurred at 100, 250, and 500 mg/kg/day and a reduction of food consumption occurred at 100, 250, and 500 mg/kg - in F₁ males and F₂ females. Pup litter weights were decreased in all dosage groups.
- b. One Generation Reproduction Study - Rats: Rats were fed a diet of 6, 12.5, and 25 mg/kg/day. No treatment related effects due to captan were seen. (The NOEL for these studies (a and b) when combined, is 12.5 mg/kg/day.)

Mutagenicity

i. Gene Mutation

- o In vivo somatic mutation assay with mice - no mutations were observed.
- o Captan was mutagenic to various strains of S. typhimurium in saline. Decreased mutagenicity was observed when captan was incubated with blood or urine. Captan was not mutagenic in the host mediated assay in mice or rats with S. typhimurium hisG46 or TA1950. Negative findings were also obtained in vitro with blood or urine of captan-treated mice or rats.
- o Captan was mutagenic for point mutations in E. coli and

S. typhimurium. However, it did not produce heritable chromosome aberrations in vivo (this was the conclusion of a working group chaired by W. M. Generoso.)

- o Captan was not mutagenic for the dominant lethal test using C3H male and SLR-ICR female mice. No significant increases in chromosomal aberrations were observed in human fibroblasts in vitro or in bone marrow cells of Wistar rats in vivo.

ii. Chromosomal Aberrations

- o Chinese hamster V79 cells were treated with captan technical at concentrations up to 6.0×10^{-5} M. Chromosomal aberrations were observed at 4.5×10^{-5} . Increased frequency of sister chromatid exchanges were observed at 1.5×10^{-5} M and above.

iii. Unscheduled DNA Synthesis (UDS)

- o WI-38 cells were incubated with captan technical and tritiated thymidine for 3 hr without or 1 hr with S-9 activation. The DNA was extracted and the incorporated labeled thymidine counted. Captan did not induce UDS in WI-38 cells.

Chronic Toxicity (feeding)

a. Rat

In a rat feeding study at 0, 25, 100 and 250 mg/Kg/day treatment-related neoplasms (renal tubular adenomas and carcinomas) in males were observed at 100 and 250 mg/Kg/day. The LEL was 100 mg/kg/day based on hepatocellular hypertrophy, increased kidney weight (male and female) and decreased body weight (male and female). The NOEL was 25 mg/Kg/day. This study partially satisfies the chronic testing requirement for registration.

Oncomogenicity (feeding)

a. Rat

See a above, chronic toxicity in the rat.

b. Mouse (high dose study)

In a CD-1 mouse study technical captan at dietary concentrations of 6,000, 10,000, and 16,000 ppm induced both benign and malignant duodenal tumors in both males and females.

c. Mouse (low dose study)

In a second CD-1 mouse study there was an increased incidence of focal hyperplasia, adenoma/polyp(s) and primary carcinomas in the gastrointestinal track of both male and female mice at the highest level tested (6,000 ppm) and a possible increase at the lower dosage levels.

Physiological and Biochemical Behavioral Characteristics:

Foliar Absorption: Captan and/or its metabolites and degradates is (are) absorbed by roots and shoot of plants.

Translocation: Captan and/or its metabolites and degradates is (are) translocated in plant tissue. Captan and/or its metabolites and degradates is (are) absorbed and translocated within plants as a result of seed treatment, soil treatment and foliar application.

Mechanism of Pesticidal Action: Unknown

Metabolism and Persistence in Plants and Animals: The metabolism and accumulation of captan in plants are not understood. The metabolism of captan is understood for ruminants but not for avian species.

Environmental Characteristics: Data gap

Ecological Characteristics:

Hazards to Fish and Wildlife

Bluegill sunfish 96 hr LC₅₀ = 0.047 - 0.111 ppm
Rainbow trout 96 hr LC₅₀ = 0.066 - 0.080 ppm
Characterized as "very highly toxic" to both cold water and warm water fish.

Daphnia magna: 48 hr LC₅₀ = 7.06 - 9.96 ppm
Moderately toxic to aquatic invertebrates.

Avian Toxicity: LC₅₀ = quail > 2400 ppm

Avian Reproduction: Available data indicate that captan does not impair avian reproduction.

Potential problems related to endangered species. The Agency has made a preliminary finding that the use of captan as a fungicide in rice, cranberries, and citrus may affect the status of endangered birds, fish, and insect species. An endangered bat may be affected by the use of captan on taro in Hawaii. The Agency will seek the opinion of the U.S. Fish and Wildlife Service in these matters, to better determine what, if any, actions are necessary to protect these species.

Efficacy Review Results:

Captan product registrations with EPA have been supported with efficacy data. Tolerant strains of target plant pathogens have not been reported.

Tolerance Assessments:

1. List of Crops and Tolerances:

The following table lists the present status for tolerances in parts per million (ppm) for residues of captan:

Raw Agricultural Commodity	Part Per Million in Captan Residues			
	U.S.	Canada	Mexico	Codex
ALMOND, HULLS	100.0I*	-	-	-
ALMONDS	2.0I	-	-	-
APPLES	25.0**	5.0	25.0	25.0
APRICOTS	50.0	5.0	-	20.0
AVOCADOS	25.0	-	-	-
BEANS, DRY	25.0I	-	25.0	-
BEANS, SUCCULENT	25.0I	-	25.0	10.0
BEETS, GREENS	100.0	-	-	-
BEETS, ROOTS	2.0	-	-	-
BLACKBERRIES	25.0	-	-	-
BLUEBERRIES (HUCKLEBERRIES)	25.0	5.0	-	20.0
BROCCOLI	2.0	-	2.0	-
BRUSSELS SPROUTS	2.0	-	-	-
CABBAGE	2.0	-	2.0	-
CANTALOUPS	25.0	-	25.0	-
CARROTS	2.0	-	2.0	-
CATTLE, FAT	0.05	-	-	-
CATTLE, MBYP	0.05	-	-	-
CATTLE, MEAT	0.05	-	-	-
CAULIFLOWER	2.0	-	2.0	-
CELERY	50.0	-	50.0	-
CHERRIES	100.0	5.0	-	50.0
COLLARDS	2.0	-	-	-
CORN, SWEET (K+CWHR)	2.0	-	2.0	-
COTTON, SEED	2.0	-	2.0	-
CRABAPPLES	25.0	5.0	25.0	25.0
CRABERRIES	25.0	5.0	-	10.0
CUCUMBERS	25.0	-	25.0	10.0
DEWBERRIES	25.0	-	-	-
EGGPLANT	25.0	-	-	-
GARLIC	25.0	-	25.0	-
GRAPEFRUIT	25.0I	-	-	15.0
GRAPES	50.0	5.0	-	-

*I Interim tolerance pending evaluation (under Special Review) of transfer of captan residues to meat, milk, and eggs from feeding the raw agricultural commodity or their byproducts.

** Established tolerance under regulation, Section 180.103, 40 CFR.

Continued

Raw Agricultural Commodity	Part Per Million in Capitan Residues			
	U.S.	Canada	Mexico	Codex
HOGS, FAT	0.05	-	-	-
HOGS, MBYP	0.05	-	-	-
HOGS, MEAT	0.05	-	-	-
HONEYDEW MELONS	25.0	-	25.0	-
KALE	2.0	-	-	-
LEEKs	50.0	-	-	-
LEMONS	25.0I	-	-	15.0
LETTUCE	100.0	-	100.0	10.0
LIMES	25.0I	-	-	15.0
MANGOES	50.0	-	50.0	-
MUSKMELONS	25.0	-	25.0	-
MUSTARD, GREENS	2.0	-	-	-
NECTARINES	50.0	-	-	-
ONIONS, DRY BULB	25.0	-	25.0	-
ONIONS, GREEN	50.0	-	50.0	-
ORANGES	25.0I	-	-	15.0
PEACHES	50.0	5.0	40.0	15.0
PEARS	25.0	5.0	25.0	25.0
PEAS, DRY	2.0	-	2.0	-
PEAS, SUCCULENT	2.0	-	2.0	-
PEPPERS	25.0	-	-	10.0
PIMENTOS	25.0	-	-	10.0
PINEAPPLES	25.0I	-	25.0	-
PLUMS (FRESH PRUNES)	100	5.0	-	10.0
POTATOES	25.0I	-	2.0	15.0
PUMPKINS	25.0	-	-	-
QUINCES	25.0	-	-	-
RASPBERRIES	25.0	5.0	-	10.0
RHUBARB	25.0	-	-	15.0
RUTABAGAS, ROOTS	2.0	-	-	-
SHALLOTS	50.0	-	-	-
SOYBEANS, DRY	2.0	-	2.0	-
SOYBEANS, SUCCULENT	2.0	-	2.0	-
SPINACH	100.0	-	100.0	20.0
SQUASH, SUMMER	25.0	-	-	-
SQUASH, WINTER	25.0	-	-	-
STRAWBERRIES	25.0	5.0	25.0	20.0
TANGERINES	25.0I	-	-	15.0
TARO (CORN)	0.25	-	-	-
TOMATOES	25.0	5.0	-	15.0
TURNIPS, GREENS	2.0	-	-	-
TURNIPS, ROOTS	2.0	-	-	-
WATERMELONS	25.0	-	25.0	-

A feed additive regulation (§561.65, Title 21, Code of Federal Regulations; Parts 500 to 599) permits residues of captan at 100.0 ppm remaining on corn seed from its intended use as a seed protectant after detreatment. Detreated corn seed can be used only as a feed for cattle and hogs up to 14 days prior to slaughter.

A food additive regulation (§193.40, Title 21, Code of Federal Regulations Parts 170 to 199) permits 50.0 ppm residues of captan in or on washed raisins when present as a result of fungicidal treatment by preharvest application to grapes and postharvest application during the drying process.

No tolerances have been established for captan residues in or on any crop commodity for which captan is registered solely for seed or plant propagule application, because heretofore seed or plant propagule applications were considered as nonfood uses. Seed use sites are listed under Use Patterns and Formulations.

Data Gaps in Residue Chemistry

- o Available plant metabolism data are not completely adequate for identifying the metabolites that may result from the maximum uses and necessary to support the established tolerances.
- o Available animal metabolism data are not adequate to support the tolerances in meat; and to establish tolerances in milk, and poultry and eggs.
- o For enforcement purposes, FDA's Pesticide Analytical Manual, Method I, Vol. II, Pesticide Regulation Section 180.103 is acceptable for plant commodities. No validated method is available for enforcement of tolerances for residues of captan in animal commodities.
- o Inadequate data are available on the storage stability of residues of captan in animal commodities or in or on plant commodities.
- o The following uses need tolerances to allow continued registrations:

California, Special Local Needs registration CA780027 - Use of captan as a seed treatment or as a root dip in the culture of asparagus.

Washington, Special Local Needs registration WA800035 - Use of captan as a seed treatment or as a soil treatment in the culture of kohlrabi.

Use-patterns for treatment of soil and greenhouse benches in which vegetables (without tolerances) are grown.

- o The data are insufficient to assess the established tolerance for residues in or on detreated seed corn because no data were submitted depicting residues resulting from detreated seed that originally had been treated at the maximum allowable rate. A mechanism must be implemented to prevent the feeding of detreated seed corn which contains residues of pesticides in addition to those of Captan.

- o Heretofore, seed treatments and plant propagule treatments have been considered nonfood uses. Available plant metabolism data indicate that residues of captan may be taken up into mature plants from treated seed. Therefore, seed treatments are uses for which residue data and requests for EPA Pesticide Petitions for proposed tolerances must be submitted.
- o Processing studies are required for the following commodities: potatoes, beans, soybeans, tomatoes, oranges, plums, sweet corn, and cottonseed.
- o Captan may be used as a component of paper and paper board that may come in contact with aqueous and fatty foods [21 CFR 176.170(c)]. Residue data to support this regulation are required to support the EPA registered use-pattern. Alternatively, label amendments are required to restrict the use of captan-treated packing boxes for fruits and vegetables having tolerances for residues of captan.
- o The theoretical maximum residue contribution (TMRC) from established tolerances is 12 mg/day based a 1.5 kg diet. The changes in the residue definition, the requested tolerance proposals, and the pending tolerances noted above will all affect a change in the TMRC level. The data requirements to support established tolerances as listed in 40 CFR 180.103 are identified.
- o The Provisional Maximum Permissible Intake (PMPI) for a 60 kg person is 0.75 mg/day based on a Provisional Acceptable Daily Intake (PADI) of 0.0125 mg/kg. The present TMRC represents 1600 percent of the PMPI. The inclusion of the major metabolite (THPI) in the tolerance expression may result in an increase in the TMRC and a greater percentage of the PMPI utilized.
- o The PADI for captan is based on a reproductive toxicity study in rats. A no-observed-effect level (NOEL) was established at 12.5 mg/kg/day for decreased pup weights. A safety factor of 1000 is used to derive the PADI because there was only chronic data on one species. The PADI will be changed to an ADI when chronic data on a second species (nonrodent) are submitted and found adequate. The data from the most sensitive species and a safety factor of 100 will be used. The NOEL of 12.5 mg/kg/day was based on reproductive toxicity excluding the issue of oncogenicity for which a risk assessment has been made.

4. Summary of Regulatory Positions and Rationale

The Agency has concluded that studies conducted with mice and rats have shown statistically significant increases in incidences of certain tumors. Use of captan results in dietary and environmental exposure that may pose unreasonable risks to human health unless certain steps are taken. Accordingly, the Agency proposed in the Federal Register of June 21, 1985 (50 FR 25884) to cancel or deny federal registrations of products containing captan for use on food crops with the proviso that in the final decision EPA would continue any use on food where data submitted demonstrate that captan residues on food

are sufficiently lower than EPA's estimates or that alternative application methods will sufficiently reduce dietary exposure to captan. EPA also proposed in its preliminary determination that protective clothing and/or equipment be worn or used for specific non-food agricultural and non-agricultural uses of captan and that revised labeling be required on products intended for non-food uses. Extensive dietary data are due from registrants in May, 1987. A decision document, Position Document Number 4, is expected to be issued in August, 1988.

Required labeling reflects use restrictions needed to reduce human exposure to captan. The following areas of labeling will be required within 90 days from the receipt of the Standard:

1. Ingredient Statements
2. Precautionary Statements
3. Environmental Hazards Statements
4. Use Precaution Statements

Summary of Risk/Benefit Review

An EPA document entitled "Intent to Cancel Registration of Pesticide Products Containing Captan; Availability of Position Document 2/3 (50 FR 25884-25899, June 21, 1985) discusses the risks and benefits of captan.

5. Summary of Major Data Gaps

- Product Chemistry
- Toxicology
 - Acute Testing
 - Subchronic Testing
 - Chronic Testing
 - Special Testing
- Environmental Fate
 - Photodegradation
 - Metabolism Studies - Laboratory
 - Mobility Studies
 - Dissipation Studies Field
 - Accumulation Studies
 - Subdivision K, Reentry Studies
- Wildlife and Aquatic Organisms
 - Aquatic Organism Testing
 - Nontarget Insect Testing - Aquatic Insects
- Residue Chemistry

6. Contact person at EPA

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